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GAS-LIQUID CONTACT APPARATUS

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ABSTRACT OF THE DISCLOSURE

A decomposer chamber for use in the subhalide process for the refining of aluminnm containing molten aluminum with a gas space thereover and aluminum monohalide gas inlet and egress openings into the chamber gas space, having one or more helical screw-lifts extending above and below the liquid level in the chamber, for continuous rotation to draw liquid upward into the gas space and then scatter it across the gas space in relatively small droplets relatively uniformly distributed throughout, the screw-lifts each having at least one helical passageway rising upwardly therealong and totally enclosed except for a plurality of orifices therein adapted to allow the emission of liquid therefrom in relatively fine streamlets laterally impelled by centrifugal force on the liquid in the helical rotating passageway. The totally enclosed nature of the helical passageway or passageways together with the multiplicity of orifices in the peripheral surface thereof, provides a great improvement over prior art structures in several respects directly pertinent to gas-liquid contact efficiency, particularly the production of very fine droplets and in the uniform distribution of droplets throughout the gas space and especially close to the screw-lifts themselves.

BACKGROUND OF THE INVENTION

In many processing situations a molten metal or salt or a more ordinary liquid must be intermittently contacted with a stream of gas either for the purpose of cooling the gas or liquid with the other, or for absorbing the gas into the liquid. The problem common to these situations is the need to achieve very large area of contact between liquid and gas in a relatively compact apparatus. A common form of solution to this classic problem has been to spray the liquid, generally by mechanical agitation, into the vapor space containing the gas. In U.S. Pat 3,311,363 to N. W. F. Phillips et al., issued Mar. 28, 1967, and assigned to a common assignee with the present invention, there is shown an important advance in the art of gas-liquid contact apparatus, and particularly in the art of contact of molten high temperature liquids with higher temperature gases.

There is shown in that patent employment of a helical screw-lift which when rotated lifts the molten liquid above the liquid level and into the gas space, and then releases it tangentially throughout the gas space by centrifugal force upon the liquid causing it to spill over the open helical channel or trough and be emitted therefrom laterally. The apparatus of that patent constitutes an important advance in the art of gas-liquid contact techniques, but because there is always room for improvement in the efficiency of gas-liquid contact, no apparatus can be the final solution to the problem. That is to say, an apparatus which can produce finer droplets and distribute them more evenly than that of the aforesaid patent, while preserving the other desirable characteristics of that patent, will constitute an advance thereover. The present invention is the result of attempts at coming still closer to the never-attainable ideal of maximum gas-liquid contact surface so that the most efficient process dependent thereon, e.g. absorption or heat exchange or the like, is more closely approached.

SUMMARY OF THE INVENTION

For use in a chamber containing liquid with a gas space thereover and gas inlet and egress openings into the chamber gas space, having one or more helical screw-lifts extending above and below the liquid level in the chamber, for continuous rotation to draw liquid upward into the gas space and then scatter it across the gas space in relatively small droplets relatively uniformly distributed throughout, an improved screw-lift comprising at least one helical passageway rising upwardly therealong and totally enclosed except for a plurality of orifices therein adapted to allow the emission of liquid therefrom in relatively fine streamlets laterally compelled by centrifugal force of the liquid in the helical rotating passageway. The totally enclosed nature of the helical passageway or passageways together with the multiplicity of orifices in the peripheral surface thereof, provides a great improvement over prior art structures in several respects directly pertinent to gas-liquid contact efficiency, particularly the production of very fine droplets and in the uniform distribution of droplets throughout the gas space and essentially close to the screw-lifts themselves.

BRIEF DESCRIPTION OF THE FIGURES

The invention is shown in the accompanying drawings in one illustrative, but not limiting embodiment thereof, in which:

FIG. 1 is a perspective view of a screw-lift according to the invention partially broken away to show details thereof;

FIG. 2 is a sectioned plan view of a portion of a gas-liquid contact apparatus according to the invention employing a plurality of screw-lifts such as that shown in FIG. 1 but reduced in scale therefrom for purposes of illustration; and

FIG. 3 is a section view of the unsectioned apparatus of FIG. 2 viewed along plane 3—3 therein.

DETAILED DESCRIPTION OF THE INVENTION

Referring now to the drawings, there is shown the improved screw-lifts according to the invention embodied and employed in a decomposer apparatus for use in the subhalide process for the refining of aluminum. Embodiment and employment in numerous other forms of gas-liquid contact apparatus, wherein a gas-space overlies a liquid, is equally advantageous with the present invention. The decomposer within which the screw-lifts according to the present invention are deployed is identical to that shown in U.S. Patent 3,311,363 to N. W. F. Phillips et al. (hereinafter termed the Phillips patent), issued Mar. 28, 1967, and assigned to a common assignee with the present invention.

A decomposer indicated generally at **10** in FIGS. 2 and 3 comprises a refractory material structure **11** preferably, but not necessarily, manufactured from refractory bricks and having a metallic outer shell **12**. The interior of decomposer **10** constitutes a plurality of chambers **13**, said chambers being serially interconnected by a plurality of passageways **14**. The general purpose of decomposer **10** is to contact aluminum monohalide gas at an elevated temperature, with molten aluminum in each of chambers **13**, the aluminum monohalide gas traversing the chambers in serial fashion by means of passageways **14**, so that the gas may be cooled by the liquid metal and thus decomposed into aluminum and aluminum trihalide. Within each of chambers **13**, in order to effect this general purpose, must be situated means for contacting a great area of the molten aluminum with the traversing gas, which contains the monohalide, usually in admix-